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## 4. DELTA FLOW CIRCULATION

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**DRAFT - For Discussion Only**

**Distinguishing Characteristics**  
October 15, 1997

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E-001520

## Delta Flow Circulation Supporting Information

The Delta Simulation Model results show Delta circulation (flow patterns) which affect movement (transport) of fish. A relative qualitative assessment will provide the highest rank to the alternatives with the best flow circulation for fish. These include a good net outflow from the San Joaquin River with minimization of reverse flow. Reducing the amount of San Joaquin River water that is recirculated through the export pumps would increase the amount of San Joaquin water getting into the Central Delta and eventually into the western Delta benefits fish habitat through greater productivity of these waters. Minimization of cross Delta flows would also benefit flow circulation for fisheries.

### Definition

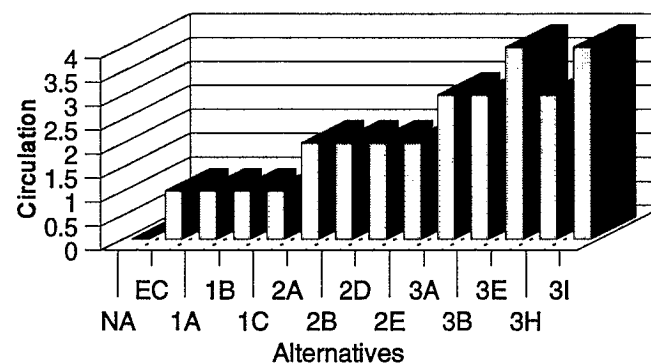
“Delta Flow Circulation” is intended to include the **direct and indirect effects of water flow circulation on fisheries due to the export diversions and changes in cross-Delta water conveyance facilities**. These will vary depending on diversion location, size, type, and operation of conveyance facilities, and annual volume of water diverted.

### Summary

Alternatives that export all or the majority of the export water out of the south Delta will cause unnatural flow patterns in the south Delta (negative Old and Middle River flows), north Delta (greater southerly flows in the Mokelumne channels), and west Delta (lower and more negative net Central Delta flows in lower San Joaquin channel between Antioch and Old River). These unnatural patterns are detrimental to fish by altering migration ques and diminishing the productivity of habitats. Alternatives that export all water from the North Delta through isolated facilities would allow natural flow patterns in the Delta, but would continue to export freshwater and nutrients that contribute to habitat value, but at a lessor rate than existing conditions. Alternative that divert a portion of the water from the North Delta would provide intermediate effects from the two described above. Increasing the flow across the Delta via new facilities near Hood would increase flow into the interior Delta and corresponding decrease flow in the lower Sacramento River below the diversion and in Sutter and Steamboat sloughs

### Flow Circulation

For Fisheries



□ 0= poor circulation, 5= good circulation

as well. Such changes may increase downstream migration deflection from the Sacramento River into the Delta, and reduce habitat quality further in the interior Delta through lowering residence time of water. Increased capacity of south Delta channels along with greater pumping capacity at south Delta pumps would cause greater than existing flows in Old and Middle River upstream toward the south Delta pumping plants, which would reduce habitat values and alter migration cues further than under existing conditions. A barrier at the head of Old River allows most San Joaquin water to move down the San Joaquin channel rather than flow toward the south Delta pumping plants via the Old River and adjacent channels in the south Delta. Increasing the amount of San Joaquin water getting into the Central Delta and eventually into the western Delta benefits fish habitat through greater productivity of these waters. Alternative that add habitat area through setbacks and open conveyance systems provide additional migratory, spawning, and rearing habitat, as well as more potential overall biological productivity, which together should benefit fish populations in general. Storage adds a degree of operational flexibility that can be used to adjust seasonal flow differences.

**Alternative 1** variations with the existing diversion configuration change circulation in the Delta little from existing conditions. Some improvements are provided by improved fish protection facilities at the Delta pumping plants and by improved timing of diversions allowed by new storage and increased diversion capacity at the south Delta pumping plants. However, greater pumping capacity and higher potential for upstream (negative) Old and Middle River flows with improved south Delta facilities may reduce the habitat value of the central and south Delta.

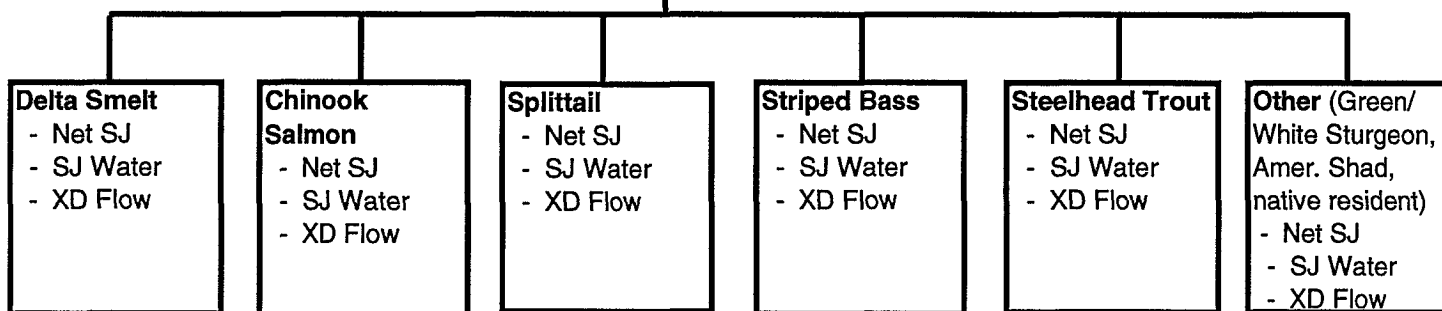
**Alternative 2** variations offer improvement in central and western Delta habitat and migration by providing positive net Central Delta outflow substantially improved over alternative 1 variations and existing conditions. Higher cross-Delta flows however reduce habitat value and migration problems in the north and southern Delta. Greater cross-Delta flows in combination with the barrier at the head of Old River allow greater amounts of San Joaquin water to reach the central and western Delta, which would benefit fish habitat and improve migration of San Joaquin fish through the Delta. Substantial increases in habitat provided in alternative 2B, 2C, and 2E should provide reduced detrimental flows in the Mokelumne and south Delta channels.

**Alternative 3** variations offer substantial improvements in fish habitat and migration by restoring greater degrees of natural circulation to the Delta. More positive net Central Delta outflow, reduced cross-Delta flows from the north through the south Delta, positive Old and Middle River downstream flows, and greatly reduced diversion of San Joaquin water provide greatly improved fish habitat and migration. Alternative 3E and 3I have the greatest potential improvement with fully isolated facilities. Fully isolated facilities (1) eliminate cross-Delta flows completely, (2) virtually eliminate export of San Joaquin water, and (3) provide positive net Central Delta outflow to the greatest extent. They fail to reach the full potential because they continue to export water from the north Delta, which reduces potential freshwater and nutrient input to the Delta and Bay, and reduces migratory transport and ques along the lower Sacramento River, and Sutter and Steamboat sloughs. Alternative with partially

isolated facilities (3A, B, H) offer performance (1-3) that is intermediate between alternatives 2 and the fully isolated alternatives as they have a combination of through-Delta and isolated facilities. Alternatives 3H retain like its counterpart alternative 2E, provides large areas of additional habitat and higher residence times that would benefit production and migration for many species.

The above chart shows preliminary estimates of Delta flow circulation (to benefit fisheries transport) for the alternatives. The most desirable circulation in the chart and Table 4.1 is given a score of "5" and the least desirable circulation is given a score of "0".

## Delta Flow Circ.

**4. Delta Flow Circulation**

To  
Decision  
Matrix

**Table 4.1 Summary**

Alternative	Delta Smelt			Chinook Salmon			Splittail			Striped Bass			Steelhead Trout			Other			Overall Score
	Net SJ	XD	SJ	Net SJ	XD	SJ	Net SJ	XD	SJ	Net SJ	XD	SJ	Net SJ	XD	SJ	Net SJ	XD	SJ	
Exist. Cond.	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
No-action	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
1A	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
1B	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
1C	1	1	1	1	1	2	1	1	2	1	1	1	1	1	2	1	1	2	1
2A	3	0	2	3	0	3	3	0	3	3	0	2	3	0	3	3	0	3	2
2B	3	1	2	3	1	3	3	1	3	3	1	2	3	1	3	3	1	3	2
2D	3	1	2	3	1	3	3	1	3	3	1	2	3	1	3	3	1	3	2
2E	3	2	2	3	2	3	3	2	3	3	2	2	3	2	3	3	2	3	2-3
3A	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	3
3B	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	3
3E	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3H	4	2-4	3	4	2-4	3	4	2-4	3	4	2-4	3	4	2-4	3	4	2-4	3	3-4
3I	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Values are on a scale from 0 to 5; with 5 representing the best performance and 0 representing the worst performance.

## Supporting Information for Table 4.1

The July 1997 draft environmental impacts technical report, *Fisheries and Aquatic Resources*, was used as a reference.

The circulation effects on fisheries for each alternative are rated here on a scale from 0 to 5. ("0 represents poor performance and "5" represents high performance.) The following rankings by alternative are based on qualitative assessments using available information.

### **Existing and No-Action Conditions**      **Score = 0 and 1, respectively**

Existing circulation conditions are given a score of 0 because existing habitat and migration conditions are poor. Low performance under existing conditions from poor habitat and migrating conditions are only slightly improved under the no-action through improved project operations; thus the No-Action alternative was given a score of 1.

### **Alternative - 1A**      **Score = 1**

This alternative alters circulation little compared to the No-Action alternative; thus it is given a score of 1.

### **Alternative - 1B**      **Score = 1**

This alternative alters circulation little compared to the No-Action alternative; thus it is given a score of 1.

### **Alternative - 1C**      **Score = 1**

The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to slightly improve circulation. The Barrier at Head of Old River would also slightly improve habitat quality and migration cues from the San Joaquin River. Overall improvements would be minor when compared to alternatives 1A and 1B; therefore the score is 1.

**Alternative - 2A      Score = 2**

This alternative provides substantial improvement in net Central Delta outflow and the amount of San Joaquin water reaching the Delta; however higher cross-Delta flows are detrimental to habitat and migration of fish. [ It should be recognized that net Central Delta outflow is just an indicator, and that the magnitude of tidal excursion will overpower this for significant periods.] On balance there is some improvement over alternative 1 variations to provide a score of 2.

**Alternative - 2B      Score = 2**

This alternative provides the similar habitat and migration conditions as Alternative 2A. The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to slightly improve circulation to benefit fish. Habitat improvements (setbacks) in the Delta would also benefit. These benefits would not sufficiently increase the score above 2.

**Alternative - 2D      Score = 2**

This alternative provides nearly the same benefits, effects, and uncertainties as alternatives 2A and 2B; thus it received a score of 2.

**Alternative - 2E      Score = 2-3**

Though facilities are similar to other variations of alternatives 1 and 2, unlike other variations of alternative 2, Alternative 2E does not have a Hood diversion facility, and instead diverts water through an opening near the head of Georgiana Slough. Though this also contributes to poor Delta circulation, the substantial new habitat and lack of new Hood diversion may provide uncertain additional habitat and circulation benefits that would not occur with previous alternatives, thus a score of 2-3 was given.

**Alternative - 3A      Score = 3**

This alternative provides the same fish facilities as alternative 1B but adds a screened diversion at Hood and a 5,000 cfs isolated conveyance facility to the South Delta export facilities. The isolated facility will reduce poor circulation and habitat conditions in the Delta; thus a score of 3 was given.

**Alternative - 3B      Score = 3**

This alternative provides the same fish facilities as alternative 3A. The addition of surface storage for this alternative could improve operational flexibility between the SWP and CVP that could be used to slightly lessen the impacts of the diversion. Alternative 3B has been given a score of 3. Replacing the open channel isolated facility with a pipeline should score the same.

**Alternative - 3E      Score = 4**

This alternative is the same as alternative 3B with a 15,000 cfs isolated facility rather than a 5,000 cfs facility. As envisioned, the majority of diversions would take place through the screened intake at Hood. This would screen the majority of water at an optimum location, and would eliminate most of the unnatural circulation patterns in the Delta and improve habitat greatly. Continued diversion of freshwater and nutrients from Hood keep this alternative from scoring a 5, thus a score of 4 was given.

**Alternative - 3H      Score = 3-4**

This alternative is the same as Alternative 3B plus a through Delta conveyance/habitat corridor similar to alternative 2E. This alternative assumes Sacramento River water can be diverted into a Central Delta conveyance/habitat corridor with potentially mixed effects. Uncertainty as to the potential benefits of the greatly expanded habitat provides a score of 3-4.

**Alternative - 3I      Score = 4**

This alternative is the same as alternative 3E plus facilities for 3 additional in-Delta diversions. The operational considerations and hydraulic impacts of this alternative will be very complex, but are assumed to be similar to Alternative 3E; thus a score of 4 was given.